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AUTHOR Vandever, Thomas R.
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ABSTRACT

The purposes of this study were to assess the effect of phoneme-grapheme consistency (PGC) and cue emphasis (CE) on the development of decoding skills in first graders and to determine the relationship of consistency of original lists to the recognition of new words. Subjects were 162 first graders, mean age 6.11 years and scoring above 30 on the Metropolitan Readiness Test (MRT), randomly assigned to 18 treatment groups. Original word lists and recognition new word lists were developed for both high-PGC and low-PGC words. Subjects learned one list of eight words on each of 3 consecutive days. While all subjects learned words with all the CE methods, half the groups learned consistent words, and the other half learned inconsistent words. At the end of the last session, all subjects were given the recognition new word lists to assess their ability to decode these words. It was found that (1) there were no differences in the number of words recognized by high- and low-PGC groups for the first 2 days, but by the third day the high PGC groups recognized more words; (2) subjects recognized more auditory-CE words than visual- or kinesthetic-CE words; and (3) PGC of original lists did not affect the number of words recognized. Tables, figures, and references are included. (AW)

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IMRID Behavioral Science Monograph No. 18

THE CONTRIBUTION OF PHONEME-GRAPHEME CONSISTENCY AND CUE EMPHASIS TO DECODING IN FIRST-GRADERS

by

Thomas R. Vandever, Ph. D.

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George Peabody College for Teachers

Nashville, Tennessee

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Introduction

Educators have long been eager to utilize the extensive language competencies of beginning readers to facilitate learning to read. How best to accomplish this is a question that remains to be answered. One aspect of this problem involves the criteria for word selection in beginning reading programs. Words for many basal reading programs are selected on the basis of utility, frequency, and meaningfulness (Chall, 1967; Strickland, 1965), with little concern for phoneme-grapheme consistency (PGC). In linguistic-basal-reading series some meaningfulness in terms of highly developed stories is sacrificed in order to introduce high-PGC words, words with consistent letter-sound relationships (Bloomfield, 1942; Fries, 1963; Soffietti, 1955). If a "short a" is introduced, "long a" does not appear until much later in the program when the "short a's" have been "overlearned." High-PGC words then are characterized by consistent phoneme-grapheme correspondences across words. For example, rat, man, and gas are high-PGC words because the a has the same sound value in each word; whereas, hat, saw, and bake are low-PGC words because the a has a different sound value in each of these words.

While there is some evidence that beginning with low-PGC words facilitates transfer, (Levin & Watson, 1963a, 1963b) the effect on learning has not been well specified. Levin and Watson (1963a) found that a low-PGC list was somewhat easier to learn but in a second study (1963b), with lists matched on frequency of occurrence, the high-PGC list was easier to learn. In addition, the relationship of PGC to decoding with beginning readers as subjects has not been specified.

Levin and Watson (1963a, 1961b) used third graders who could be expected to have had considerable experience with low-PGC groups of words. The procedures used by Levin and Watson have little relationship to the methods used in the classroom to teach reading. Levin and Watson employed trials to criterion as the dependent variable, but most teachers set aside a time period for reading instruction.

Low-PGC lists should be more difficult to learn because a sound-symbol relationship learned for one word does not help in decoding a new word. High-PGC lists should be easier to learn because the sound-symbol relationships are positively related across words.

Another factor which may influence decoding is cue emphasis (CE). For the purpose of this research CE refers to cues stressed in teaching decoding skills. For example, visual CE involves the maximization of visual cues like word length, configuration, and distinctive letters. Auditory CE involves the maximization of auditory cues such as letter sounds. Kinesthetic CE involves the utilization of proprioceptive cues. Previous research has indicated that, for first and second graders, auditory CE results in faster learning. Most studies, however, have been limited because visual CE involved reading while auditory CE involved listening. Rather than determining the effectiveness of visual and auditory CE, they resulted in a comparison of listening and reading skills. Gibson, Pick, Osser, and Hammond (1962) believe that children learn to decode by learning to perceive words as groups of letters. Grouping is based on phoneme-grapheme

correspondence. Phoneme-grapheme correspondence describes the relationship between the letters in a word and its pronunciation. Words with high phoneme-grapheme correspondence are easy to spell and pronounce; those that are low are not. If these letter groupings are fundamental concomitants of learning to decode, then a method which emphasizes letter groupings should facilitate decoding. Since letter sounds are stressed when words are presented in auditory CE, that method should facilitate decoding. The effectiveness of different CEs may also be related to PGC. Auditory CE, because of the emphasis on sound-symbol relationships, may facilitate decoding of high-PGC words. Visual CE may be more effective with low-PGC words since visual cues are not dependent on sound-symbol relationships, but a word's visual properties. When confronted by high-PGC words, the beginning reader may find auditory cues reliable aids to decoding since the sound-symbol correspondences in these words are consistent. For low-PGC words these auditory cues may be unreliable because of the shifting relationship between phoneme and grapheme. The beginning reader may find visual CE highly effective with low-PGC words because visual CE minimizes the consequences of low-PGC by providing cues which are not dependent on inconsistent sound-symbol relationships.

What is the effect of prior decoding experience on the ability to decode new words, words that have not been specifically taught? Does the PGC of original lists affect the decoding of new words? Children with previous experience limited to high-PGC lists should be able to recognize new high-PGC

words. These children may be at a disadvantage when confronted with low-PGC words, since they have not had experience with words having inconsistent letter-sound relationships. Children whose decoding experience is restricted to low-PGC lists may be at an advantage decoding low-PGC new words for the same reason. However, experience with low-PGC words should not interfere with decoding high-PGC new words. As a result these children should be able to recognize a greater total number of words irrespective of PGC.

Purpose

The principle purpose of this study was to assess the effect of PGC and CE on the development of decoding skills in first-graders. A second purpose was to determine the relationship of consistency of original lists to the recognition of new words (RNW).

Hypotheses. The following hypotheses were tested:

I. Phoneme-grapheme consistency affects the number of words successfully decoded. Subjects presented high-PGC lists recognize more words than subjects presented low-PGC lists.

II. Cue emphasis affects both the number of high-PGC and low-PGC words recognized.

   A) Auditory CE results in greater learning irrespective of PGC.

   B) Visual CE is relatively more effective with low-PGC words than high-PGC words.

   C) Auditory CE of high-PGC words is relatively more effective than auditory CE of low-PGC words.

III. The PGC of lists learned originally affects RNW.

A) Prior exposure to low-PGC lists facilitates recognizing new low-PGC words.

B) Previous exposure to low-PGC lists enables subjects to recognize more new words irrespective of PGC.

C) Prior exposure to high-PGC lists enables subjects to recognize high-PGC new words but not low.

Method

Subjects

The initial sample consisted of 180 first-graders. However, seven subjects missing a session were dropped from the analysis; to maintain equal cell size nine subjects with complete data were then randomly eliminated. The final sample consisted of 84 boys and 78 girls attending three schools serving similar middle-to-lower-middle-class residential areas within the Metropolitan Nashville Public School System. The subjects had a mean chronological age of 6 years, 11 months at the time of testing, April and May, 1970. All selected children had obtained raw scores of 30 or above on the Metropolitan Readiness Test (Hildreth, Griffiths, & McGauvran, 1966). Previous research indicated that children scoring below 30 on the Metropolitan found a similar task too difficult, so subjects who scored below 30 were not included. The test had been administered by classroom teachers in October of the previous year. The Metropolitan Readiness Test was considered valid enough in these

circumstances to use as a screening device. Only children who had returned permission forms from their parents were included. Children were also excluded if they appeared to have a physical or emotional condition which the experimenter and the classroom teacher thought might negatively affect their performance. Only three children were excluded on the basis of these criteria.

Task Development

Analysis of the task of learning to decode indicates that it has much in common with paired-associate learning, especially when the influence of response learning is minimized. In learning to decode the child has the response, the spoken word, in his repertoire. The task of learning to decode is nothing more than developing ability to look at a graphic representation of a word and respond with its spoken equivalent. This is essentially a paired-associate paradigm. The stimulus is the graphic representation of the word to be learned and the response is the spoken word already in the repertoire. To ensure that response learning is not a factor it is necessary to use high-frequency words; however, this presents problems in that some children may already know how to decode these words. A solution was developed by Neville (1970) which involved presenting high-frequency words in a contrived alphabet. Neville developed a task which required subjects to learn to associate a word written in a contrived alphabet with its pictorial representation. Words could be tested by presenting the word along with several pictures and having subjects mark the appropriate picture. This task was utilized in the present study.

Lists

Three lists of high-PGC words (eight words to a list) were selected from the Merrill Linguistic Reader (Fries, 1966): an a list, in which consistent a's as in rat appeared in the medial (middle) position, an i list with consistent i's in the medial position as in hit, and an e list with consistent e's in the medial position as in jet.

Three lists of low-PGC words (eight words to a list) were selected from The Teacher's Word Book of 30,000 Words (Thorndike & Lorge, 1944). These words were matched on a word-for-word basis with the words in the consistent lists. Words were matched on frequency, formal similarity, the number of different letters used in a list; visual distinctiveness, a measure of the uniqueness of the visual properties of a word; form class, the part of speech to which a word belongs; and length. One list had variable medial a's, another list variable medial i's, and a third had variable medial e's. (See Appendix B for details of list construction.)

Two six-word RNW lists were constructed, one with high-PGC words taken from the Merrill Linguistic Reader and the other with low-PGC words. High- and low-PGC words were matched on frequency, form class, and CE. Only letters that had appeared with the same frequency in high- and low-PGC lists were used in constructing the RNW lists.

Procedure

Subjects were randomly assigned to six groups at each of three schools. These groups were then assigned randomly to 18 treatments. Subjects in groups of 10 learned one list of eight words on each of

three consecutive days. Each group learned words with all the CE methods. Half the groups learned all consistent words and the other half learned inconsistent words. At the end of the last (third) session all subjects were presented the RNW list and their ability to decode these words was assessed. Figure 1 is an outline of the procedures used.

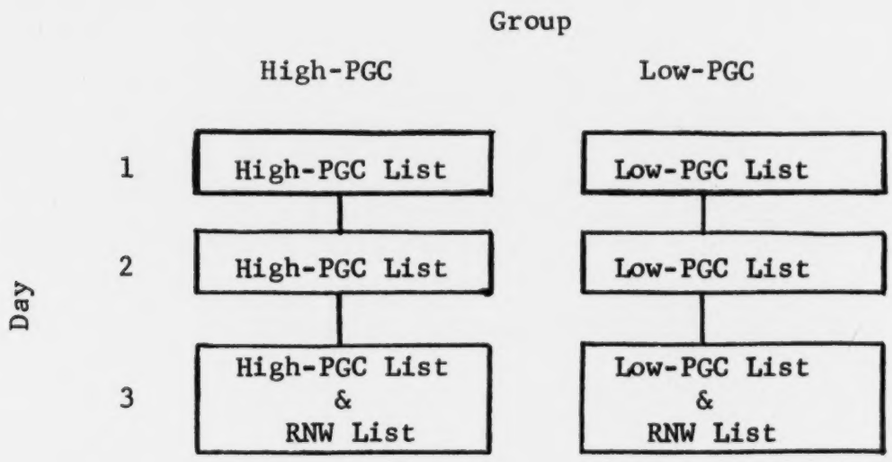

Figure 1. Outline of presentation procedures

To help insure uniformity in teaching, the teaching procedures originally developed for the Test of Modality Aptitude in Reading (TOMAR) were utilized (Neville, 1970). All subjects were read portions (depending on method) of the following statement:

> "We are going to learn some words in a new alphabet. I am going to teach you the words by showing you how they look (visual), by saying them (auditory), or by having you trace them (kinesthetic). Learn as many as you can because after we are done I will want to see how many you can remember."

Each subject was given a learning booklet which included pictures which later were to be associated with words, a practice word to introduce subjects to the procedures used in learning words by the method in use

on that day, and word-picture pairs. The examiner introduced the picture section by saying, "Here are some pictures and we will be learning some words to go with them. Put your finger on the picture of _____." After each picture had been introduced, it was tested by presenting a page with four pictures on it and asking subjects to mark the correct picture. This provided an indication of whether a word could be represented pictorially, at the same time enabling the determination of the existence of cross-lists differences in picturability. After each picture had been tested a practice word was used to introduce subjects to the CE to be used that day. The examiner said, "Here is a practice word that is going to show us how we are going to learn today".

All words appeared on the left side of the page written in a lower-case-contrived alphabet, one word to a page. The contrived alphabet maintained the essential relationships of the traditional alphabet (See Neville, 1970). Each letter was one-half inch high, except for ascending and descending letters which were three-quarters of an inch high. Letters varied from one-quarter to one-half inch in width. Visual-CE words were printed with outlines surrounding the word. Wide spaces appeared between the sound units for auditory-CE words. Kinesthetic-CE words were written in dots with dashes and arrows to indicate the direction of tracing. At the right of the word appeared the picture representing the word. A whole word approach was used in the visual-CE condition; visual configuration and distinctive letter cues, such as tall letters or descending letters, were emphasized. The auditory-CE condition involved an isolated sound unit approach in which letter sounds were introduced

then blended to form words. Tracing was added to essentially a whole word approach in kinesthetic CE. (See Appendix C for a complete outline of the teaching procedures and an example of the methods used to present words.) After the practice word had been presented, the words to be learned were introduced.

Each word was presented once for 2 minutes and 10 seconds with its pictorial representation and a foil, a picture which did not represent the word being presented. Each word was then presented a second time in a different order for 1 minute with three foils. After the learning session had been completed, the learning booklets were collected and the children had a 2 minute controlled rest period. At the end of the rest period the test booklets were handed out. The examiner said, "Now I am going to see how many words you remember". Test booklets were similar in format to the learning booklets. Each word appeared on the left of the page, one word to a page, and four pictures appeared to the right of the word. Subjects were to find and mark the picture that "goes with" the word. Each word then was tested a second time in a different order with the foils rearranged. Subjects had a maximum of 45 seconds to respond to each word.

At the conclusion of the third (last) session, the RNW pictures were introduced and tested in the same way that earlier pictures had been. Then each word, also written in the contrived alphabet, was presented with three foils and a picture representing it; the subjects' task was, as before, to match the word with its picture. No opportunity had been provided for the word to be associated with the picture. Each session,

including tests, took a total of 45 minutes except the last which included the RNW task and took 60 minutes.

Two female Caucasian examiners did the testing. Both examiners had extensive general testing experience and six months experience with TOMAR. The examiners had no idea of the experimenter's hypothesis but were told that they were standardizing another version of TOMAR.

Design

A Winer Plan 9 Design (Winer, 1962, p. 554) was used to test PGC and CE hypotheses. The between-groups factor was PGC. Cue Emphasis and Order were within-groups factors. Order was varied through the use of a Latin square. To prevent list differences from influencing the results, each list appeared an equal number of times at each level of CE. Figure 2 illustrates the design used. Equal N in each cell was obtained by randomly dropping subjects.

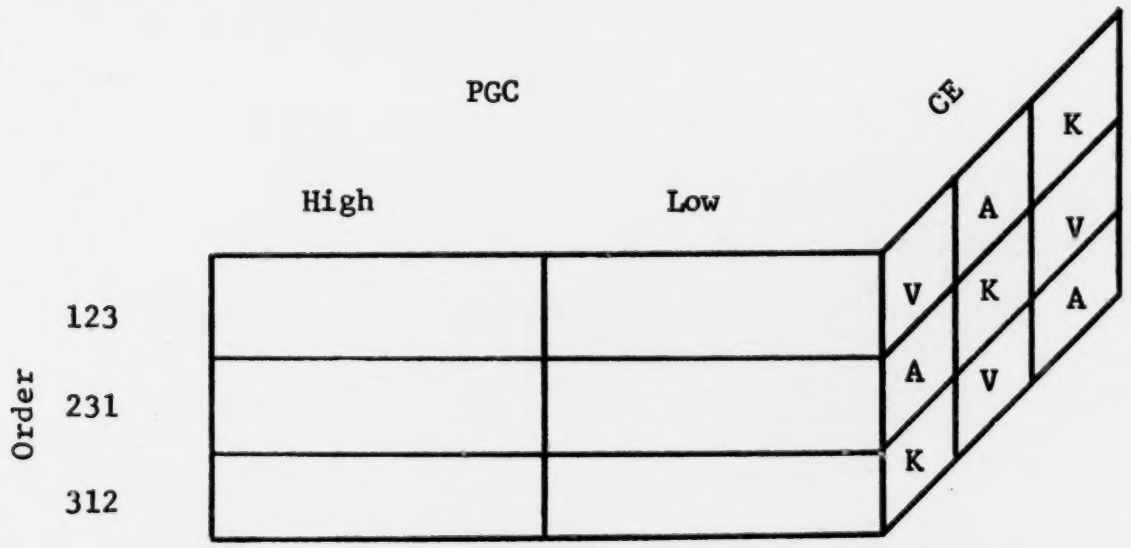

Figure 2. Winer Plan 9 Design used to test phoneme-grapheme consistency and cue emphasis hypotheses.

A Lindquist Type I Design (1953) was used to test the RNW hypothesis as shown in Figure 3. The between-group factor was PGC of original lists. The within-group factor was PGC of RNW list. The number of items correct was the dependent variable for both analyses. An alpha of .05 was chosen as the level of significance.

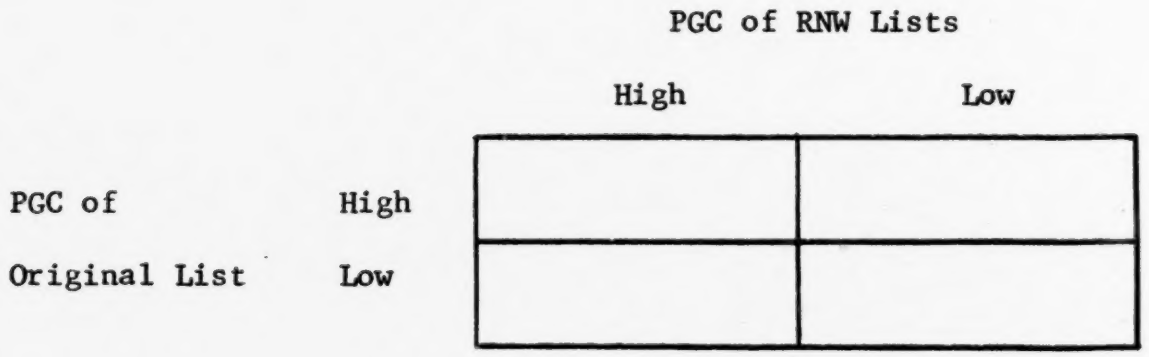

Figure 3. Lindquist Type I Design used to investigate the effect of phoneme-grapheme consistency in the recognition of new words.

Results

Table 1 shows the mean picture scores (maximum = 8) for subjects learning high- and low-PGC lists by CE. With few exceptions children were able to recognize all of the pictures.

Table 1

Picture Identification Mean Scores for High- and Low-Phoneme-Grapheme Consistency Groups by Cue Emphasis

	Cue Emphasis		
Group	Visual	Auditory	Kinesthetic
High PGC	7.80	7.93	7.91
Low PGC	7.95	7.93	7.96

Table 2 indicates that the tests were internally consistent. Alpha reliabilities ranged from a low of .68 to a high of .91.

Table 2[a]

Alpha Reliabilities by Lists and Cue Emphasis

	Cue Emphasis		
List	Visual	Auditory	Kinesthetic
High-PGC List 1	.84	.86	.85
High-PGC List 2	.87	.85	.87
High-PGC List 3	.79	.90	.91
Low - PGC List 1	.68	.80	.80
Low - PGC List 2	.82	.77	.70
Low - PGC List 3	.90	.85	.81

[a]Each alpha is based on an N of 27.

The data were tested to see if the assumptions of the designs used were met. Cochran's procedure (Winer, 1962, p. 94) was used to test both designs for homogeneity of variance. The critical value for the within-groups variance for the Winer Plan 9 design is .3135 and for the between-groups variance it is .2612. Values of .2087 and .2370 were obtained indicating that the homogeneity assumptions were met. The critical value for the Lindquist design is .6602 for both within-groups and between-groups variances. Values of .5090 and .5860 were obtained. The procedure outlined in Winer (1962, p. 369) was used to test the equality and symmetry of the covariance matrices for the Winer design. Both the hypotheses of homogeneity of covariance and symmetry were found to be tenable. There were no covariance assumptions to be met for the Lindquist design.

Table 3 shows means and standard deviations for the six treatment groups.

Table 3

Means and Standard Deviations by Lists and Cue Emphasis

	Visual CE		Auditory CE		Kinesthetic CE	
Group	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
High-PGC Group 1	6.33	3.81	9.74	4.96	8.19	5.44
High-PGC Group 2	9.81	4.23	9.52	3.07	9.52	4.17
High-PGC Group 3	6.89	4.27	9.15	5.50	5.44	3.80
Low - PGC Group 1	6.70	4.11	8.44	4.19	7.89	4.09
Low - PGC Group 2	7.70	4.37	8.85	3.98	8.19	3.91
Low - PGC Group 3	8.33	4.07	7.85	4.06	7.85	3.70

Inspection of Table 4 indicates that the first hypothesis, that PGC would affect the number of words recognized, was partially supported. The Order (Days) X Consistency interaction was significant ($p < .025$) as shown in Figure 4. There was no difference in the number of words recognized by the high- and low-PGC groups for the first two days, but by the third day the high-PGC group recognized more words ($t = 1.8498$ $p < .05$ one tail). Simple F tests within groups over Order (Days) indicated that an overall significant ($p < .01$) change occurred for high-PGC groups, but not for low-PGC groups. A Duncan's test indicated that there was a significant ($p < .05$) gain in the number of words recognized from Day 1 to Day 2 for the high-PGC groups and that the increase from Day 2 to Day 3 was not significant.

Table 4

Analysis of Variance on Phoneme-Grapheme Consistency and Cue Emphasis Data

Source	df	MS	F
Total	485	18.821	
Between	161	36.756	
PGC	1	11.574	.320
CE X Order	2	80.996	2.239
CE X Order X PGC	2	50.296	1.390
Error b	156	36.176	
Within	324	9.909	
CE	2	78.138	8.710****
Order	2	57.002	6.354***
CE X Order (w)	2	4.305	.480
CE X PGC	2	19.673	2.193
Order X PGC	2	38.265	4.265**
CE X Order X PGC (w)	2	8.469	.944
Error (w)	312	8.971	

*p < .05
**p < .025
***p < .005
****p < .001

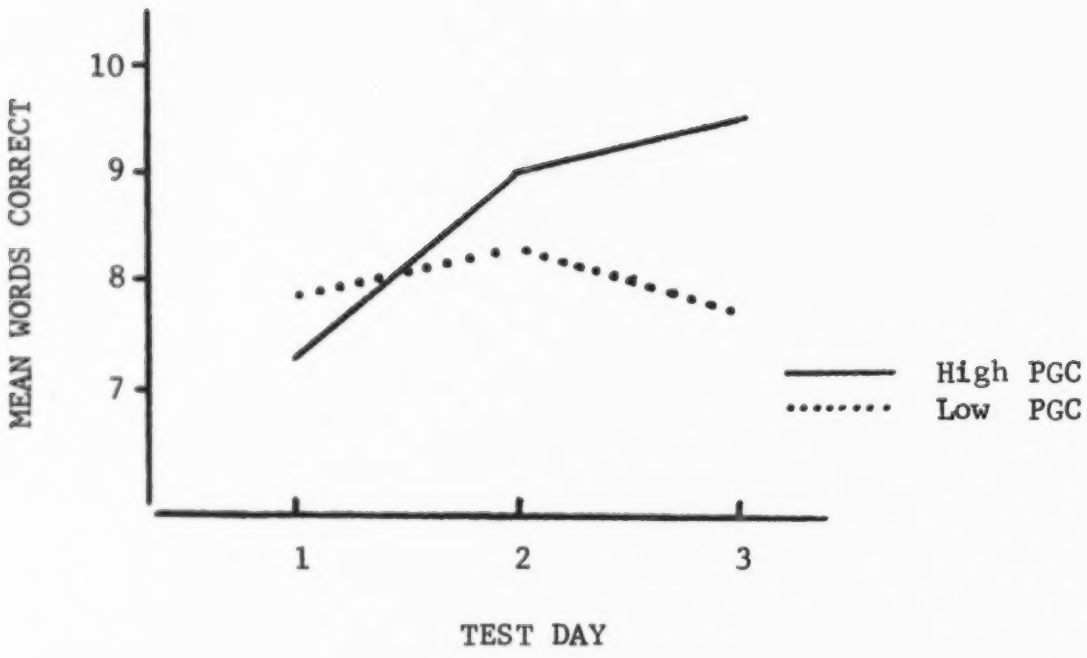

Figure 4. Order (days) X Consistency interaction.

Hypothesis two, that CE would affect the number of words recognized irrespective of Consistency, was supported ($p < .001$) as shown in Table 4. Subjects recognized more auditory-CE words than visual-CE or kinesthetic-CE words. Visual CE was not found to be more effective with low- than with high-PGC words, nor was auditory CE of high-PGC words found to be more effective than auditory CE of low-PGC words.

Mean picture scores of 11.78 and 11.74 (maximum score = 12) were obtained by the high- and low-PGC groups on the RNW pictures, indicating that the words did not differ in ease of pictorial representation for the groups. The alpha reliabilities for the high- and low-PGC lists were .50 and .59 respectively. Table 5 indicates that RNW means and standard deviations for the high- and low-PGC groups.

Table 5

Recognition of New Words, Means, and Standard Deviations

		PGC of RNW Lists			
		High		Low	
		Mean	SD	Mean	SD
PGC of Original Lists	High	2.73	1.44	2.74	1.69
	Low	2.70	1.67	2.30	1.64

The hypothesized interaction between PGC of Original List and PGC of RNW List failed to appear. Table 6 shows that PGC of Original Lists did not affect the number of words recognized.

Table 6[a]

Analysis of Variance on Recognition of New Words

Source	df	MS	F
Total	321	2.591	
Between	160	3.884	
PGC of Original Lists (A)	1	4.429	1.14
Error (b)	159	3.881	
Within	161	1.307	
PGC of RNW Lists (B)	1	2.984	2.33
A X B	1	3.421	2.67
Error (w)	159	1.283	

[a]None attained significance at the .05 level.

Discussion

The results of this study indicate that PGC affects word recognition for first-graders. The use of high-PGC lists facilitated decoding as shown by the significant increase in the mean number of words recognized from Day 1 to Day 2 for the high-PGC group. Most important, subjects exposed to low-PGC lists showed no corresponding improvement across days. By the third day subjects exposed to high-PGC lists were recognizing more words than those exposed to low-PGC lists. Subjects who were presented high-PGC lists were able to profit from their prior experience perhaps by developing a learning strategy which includes learning to attend to the phoneme-grapheme relationships. These relationships were of high utility for high-PGC lists. The performance of subjects learning low-PGC lists may not have improved because the sound-symbol relationship learned for one word did not help in decoding the next word and, in fact, may have required unlearning one relationship and learning a new one. This may have prevented the development of a learning strategy and forced these subjects to utilize less effective cues like length and configuration which did not transfer. Phoneme-grapheme consistency appears to be a useful criterion for initial word selection. A note of caution is in order. The effects of PGC of Original Lists on RNW was not clearly specified. The failure of the main effects of PGC of Original Lists to reach significance may indicate that PGC of Original Lists does not affect RNW. It is also possible that the children had not had enough exposure to the original lists to make the RNW task meaningful. That is, subjects had only had three-45 minute sessions

with the original lists; as a result the children may not have had enough exposure to the letters to allow for differences to develop. The low alpha reliabilities of the RNW task (.50 for the high-PGC list and .59 for the low-PGC list) along with the large standard deviation relative to the mean lend support to this view. The length of the last (RNW) session may have been excessive although, if this was the case, it was not reflected in behavior problems. Clearly called for is a replication of this portion of the experiment with additional exposure to the original lists and longer RNW lists to help increase reliability.

Phoneme-grapheme consistency may be more important than phoneme-grapheme correspondence as a criterion for initial word selection. Scott (1970) found that correspondence did not have a significant effect on learning with deprived first-graders as subjects. Future research effort might profitably be expended toward determining the relative contribution of PGC and correspondence to the development of decoding skills.

The cues emphasized in presenting words were important determinants of decoding. The fact that auditory CE facilitated decoding may indicate that auditory cues should be stressed when presenting words to first-graders irrespective of PGC. Samuels and Jeffrey (1966) conducted a study which may indicate the reason for the effectiveness of auditory CE. They found that training which requires the subjects to attend to each letter was more likely to result in fewer subsequent reading errors than training based on word identification through a single cue. Auditory CE provided just such cues. In other words, auditory CE may be most effective because it encourages the child to attend to letter-sound

relationships. The ineffectiveness of visual CE and kinesthetic CE may mitigate against the use of these methods with beginning readers. An analysis of these methods indicated that both are whole-word methods. (See Appendix C.) These results support the position of Gibson et al. (1962) that groups of letters are the fundamental unit of analysis in word recognition.

The fact that visual CE did not differ in effectiveness for low- and high-PGC words may be due to a restriction of visual cues. Only three- and four-letter words were used which in effect removed length as a visual cue. It is more likely that visual presentation is an ineffective method of teaching because children learning by this method utilize many cues which do not have utility for learning new words, like the tail on the word "monkey". The widespread practice of introducing low-PGC words using a whole word approach may be of limited utility. Jeffrey and Samuels (1967) found that children who had been taught to attend to the whole word when compared with children receiving letter-sound training performed less well on a second list of new words. The word-trained children did not learn the new words any faster than a third group of children who had not had any previous training.

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